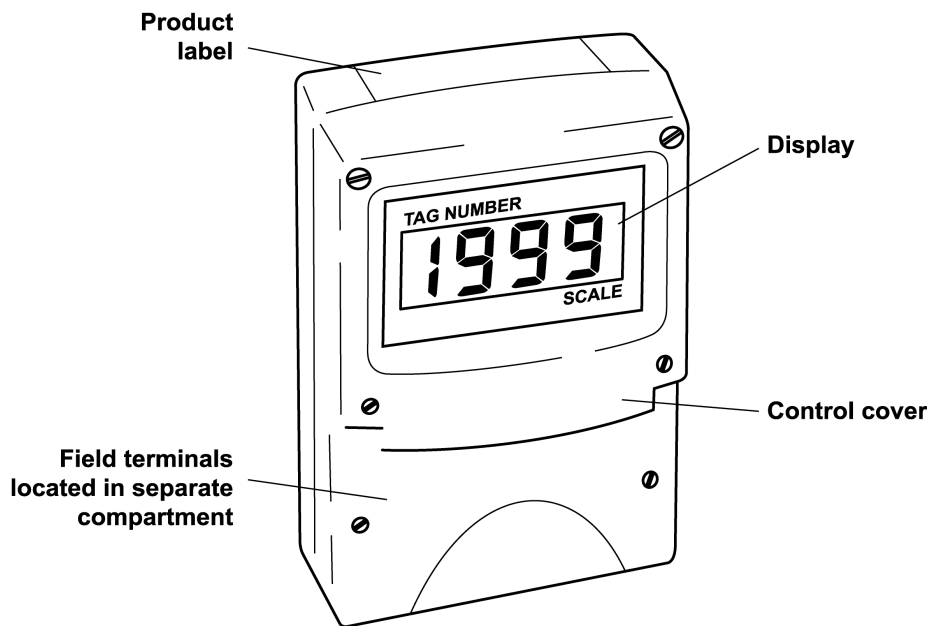


BA504D
loop-powered
3½ digit field
mounting indicator



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1. Description

The BA504D is a loop powered digital indicator which displays the current flowing in a 4/20mA loop in engineering units. The indicator introduces less than a 1.1V drop which allows it to be installed into almost any 4/20mA current loop. No additional power supply or battery is required.

The BA504D is a third generation instrument which, although having additional features including a separate terminal compartment, remains electrically compatible with the original BA504 and BA504C.

The main application of the BA504D is to display a measured variable or control signal in a process area. The zero and span of the display are independently adjustable so that the indicator may be calibrated to display any variable represented by the 4/20mA current, e.g. temperature, flow, pressure or level.

The instrument is housed in a robust IP66 glass reinforced polyester (GRP) enclosure with an armoured glass window.

2. Operation

Fig 1 shows a simplified block diagram of a BA504D. The 4/20mA input current flows through resistor R1 and forward biased diode D1. The voltage developed across D1, which is relatively constant, is multiplied by a switch mode power supply and used to power the analogue to digital converter and liquid crystal display. The voltage developed across R1, which is proportional to the 4/20mA input current, provides the input signal for the analogue to digital converter.

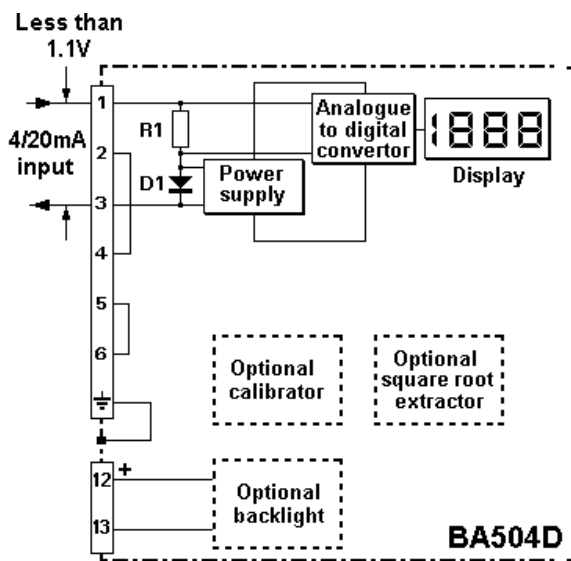


Fig 1 Simplified block diagram of BA504D

3. Applications

3.1 Transmitter loops

A BA504D indicator may be connected in series with any 4/20mA current loop that can tolerate the 1.1 V drop required to operate the instrument, and calibrated to display the measured variable or control signal in engineering units.

Fig 2 illustrates a typical application in which a BA504D indicator is connected in series with a 2-wire transmitter and controller.

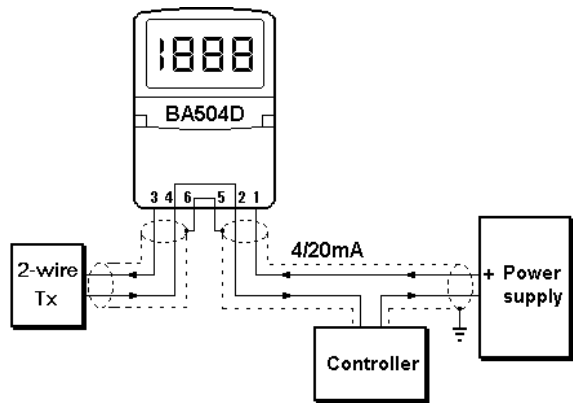


Fig 2 BA504D in a transmitter loop

Considering the example shown in Fig 2, the sum of the maximum voltage drops of all the components in the loop must be less than the minimum power supply voltage.

Minimum operating voltage of 2-wire Tx	10.0
Maximum voltage drop caused by controller	5.0
Maximum voltage drop caused by BA504D	1.1
Maximum voltage drop caused by cables	0.4

	16.5V

Therefore at 20mA the power supply in this example must have an output greater than 16.5V

3.2 Remote indication

A BA504D indicator may be driven from any 4/20mA signal to provide remote indication. Fig 3 shows a typical application in which the output from a gas analyser drives a BA504D. Again it is necessary to ensure that the voltage capability of the gas analyser 4/20mA output is greater than the sum of the voltage drops introduced by the BA504D and cable resistance.

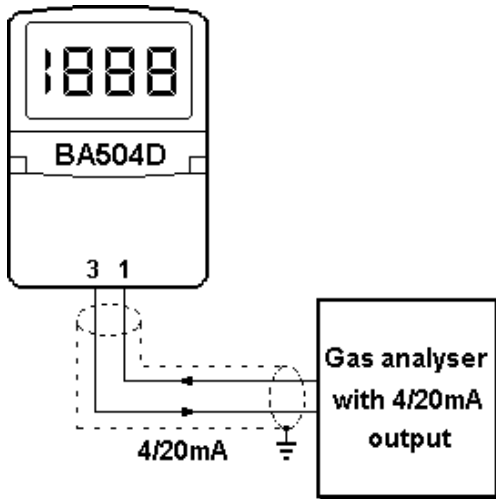


Fig 3 Remote indication

4. Installation

4.1 Location

The BA504D indicator is housed in a robust IP66 glass reinforced polyester (GRP) enclosure incorporating an armoured glass window and stainless steel fittings making it suitable for exterior mounting in most industrial applications, including off-shore and waste water treatment.

The BA504D is surface mounting, but may be pipe or stem mounted using the accessory kits described in sections 7.5 and 7.6 of this manual.

The field terminals and the two enclosure mounting holes are located in a separate compartment with a sealed cover allowing the instrument to be installed without exposing the display assembly or controls.

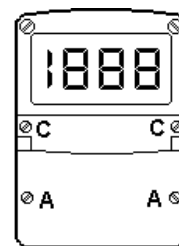
Terminals 2 and 4 are internally joined and may be used for linking the return 4/20mA wire - see Fig 2. Similarly, terminals 5 and 6 are internally joined and may be used for linking the cable screens. The BA504D earth terminal is connected to the internal EMC filters. For maximum radio frequency interference rejection this terminal should be connected to a local earth, or to an earthed cable screen. To prevent circulating currents, cable screens should only be earthed at one point.

The BA504D enclosure is fitted with a bonding plate to ensure electrical continuity between the three conduit / cable entries.

4.2 Installation Procedure

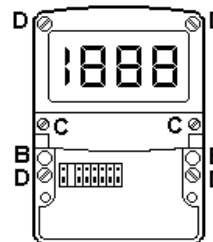
Fig 4 illustrates the instrument installation procedure.

- Remove the instrument terminal cover by unscrewing the two captive 'A' screws.
- Mount the instrument on a flat surface and secure with screws or bolts through the two 'B' holes. Alternatively use one of the pipe or stem mounting kits described in sections 7.5 and 7.6
- Remove the temporary dust seals from the three cable entries and install the required glands, conduit fittings or blanking plugs. Note: the temporary dust seals supplied with the instrument do not provide IP66 protection
- Connect the field wiring to the terminals as shown in Fig 5.
- Replace the instrument terminal cover and tighten the two 'A' screws.



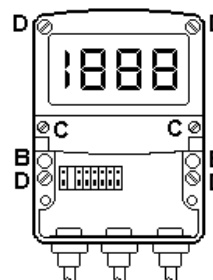
Step a

Remove the terminal cover by unscrewing the two 'A' screws



Step b

Secure the instrument to a flat surface with screws through the two 'B' holes. Alternatively use a pipe mounting kit.



Steps c and d

Install cable glands, conduit fittings or blanking plugs and terminate field wiring. Finally replace the terminal cover and tighten the two 'A' screws

Fig 4 BA504D installation procedure

4.3 EMC

The BA504D complies with the requirements of the European EMC Directive 89/336/EEC. For specified immunity all 4/20mA wiring should be in screened twisted pairs.

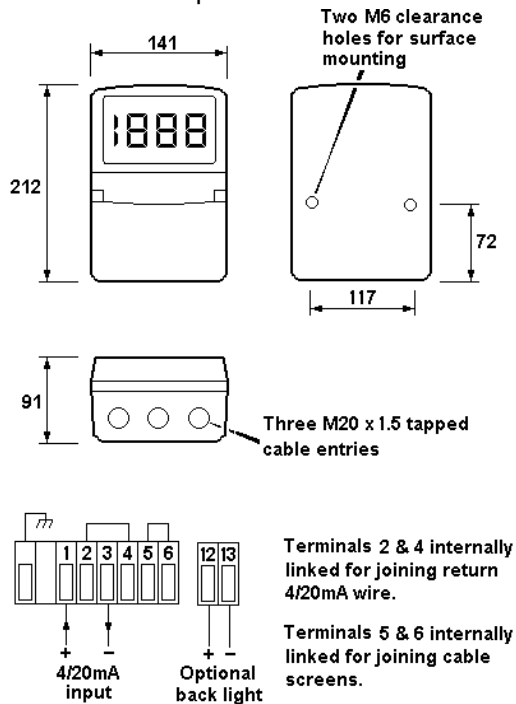


Fig 5 Dimensions and terminal connections

5. Calibration

The BA504D will be supplied calibrated as requested at time of ordering. If calibration is not requested, the indicator will be set to display 00.0 with 4.000mA input, and 100.0 with 20.000mA input.

The BA504D is conditioned and calibrated by plug-in links and two multi-turn potentiometers located behind the instrument control cover, which is secured by two 'C' screws - see Fig 4. Removal of this cover does not expose the field terminals or the display assembly. For maximum accuracy, the instrument should be calibrated using an external traceable current source with a resolution of at least 4µA. However, when verification is not required, the instrument may be fitted with an optional internal calibrator which allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current. See section 7.2 for details.

5.1 Zero adjustment

Zero is defined as the number displayed by the indicator with a 4.000mA input current, and may be adjusted between -1000 and 1000. The zero potentiometer has two ranges, 0 to 500 and 500 to 1000. Zero polarity is defined by the position of the suppression / elevation links which are shown in Fig 6.

Suppression / elevation links

Position	Display with 4mA input adjustable between
Elevation	0 and 1000
Suppression	0 and -1000

Zero link

Position	Display with 4mA input adjustable between
0 to 500	0 and 500
500 to 1000	500 to 1000

5.2 Span adjustment

Span is defined as the difference between the number displayed with 4.000mA input, and the number displayed with 20.000mA input. It is adjustable between 0 and 1999 in four ranges. Fig 6 shows the position of the span links and the span potentiometer.

Position of span links	Instrument span adjustable between
000 to 500	000 and 500
or 500 to 1000	500 and 1000
or 1000 to 1500	1000 and 1500
or 1500 to 1999	1500 and 1999

5.3 Decimal point

A dummy decimal point may be displayed between any of the four digits. The position or absence of this decimal point is determined by the position of the decimal point link shown in Fig 6. When calculating the required span and zero settings the decimal point should be ignored.

5.4 Reverse action

Normally the BA504D display increases as the input current increases, but this can be reversed. Please contact BEKA associates for details.

5.5 Calibration example

The BA504D is required to display:
 25.0 with 4.000mA input
 115.0 with 20.000mA input

i.e. A zero of positive 250 (Ignoring decimal point)
 A span of 900 (Ignoring decimal point)
 A decimal point in position 00.0

The following adjustments are required:

- Step 1 The BA504D is required to display a positive zero therefore the suppression / elevation links should be put in the elevation position.
- Step 2 The required zero is 250, therefore the zero link should be put in the 0 to 500 position.
- Step 3 The required span is 900, therefore the span links should be placed in the 500 to 1000 position.

Step 4 The decimal point is required between the two least significant digits, therefore the decimal point link should be placed in the 00.0 position.

Step 5 With 4.000mA input adjust the zero potentiometer until the indicator displays 25.0

Step 6 With 20.000mA input adjust the span potentiometer until the indicator displays 115.0

Step 7 Repeat steps 5 and 6 until both calibration points are correct. The span and zero controls are almost independent so it should only be necessary to repeat each adjustment twice.

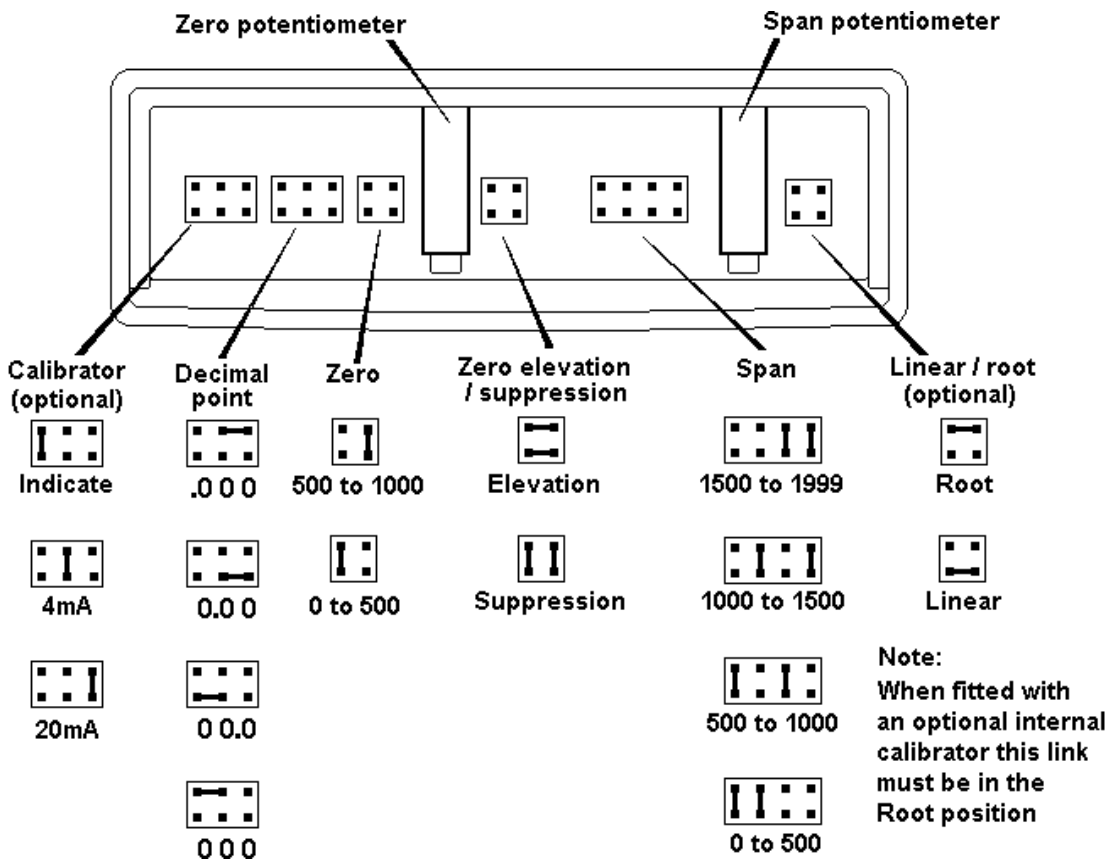


Fig 6 Position of plug-in links and potentiometers shown with the control cover removed

5.6 Over and under-range

If the indicator display range is exceeded, the three least significant digits will be blanked. Under-range is indicated by -1 and over-range by 1. If the display range is not exceeded, the BA504D will produce accurate readings outside the 4/20mA current range. Although not guaranteed, most BA504D indicators will operate between 3 and 25mA.

6. Maintenance

6.1 Fault finding during commissioning

If the BA504D fails to function during commissioning the following procedure should be followed:

Symptom	Cause	Solution
No display	Incorrect wiring	There should be 1V between terminals 1 & 3 with terminal 1 positive.
No display with no volts between terminals 1 and 3.	Incorrect wiring or no power supply.	Check that a current is flowing in the loop.
	Insufficient loop voltage to operate BA504D.	Check supply voltage and voltage drops caused by all components in the loop.
BA504D displays 1	Positive over-range	The BA504D has been incorrectly calibrated & is trying to display a number greater than 1999.
BA504D displays -1	Negative over-range	The BA504D has been incorrectly calibrated & is trying to display a number less than -1999.
Unstable display	4/20mA input has a large ripple	Check loop supply voltage.

6.2 Fault finding after commissioning

ENSURE PLANT SAFETY BEFORE STARTING MAINTENANCE

If a BA504D fails after it has been functioning correctly, the following table may help to identify the cause of the failure.

Symptom	Cause	Solution
No display with no volts between terminals 1 and 3	No power supply	Check that a current is flowing in the loop.
Unstable display	4/20mA input has a large ripple	Check loop supply voltage.

If this procedure does not reveal the cause of the fault, it is recommended that the instrument is replaced. Alternatively the electronic display assembly may be exchanged as described in section 6.3

6.3 Servicing

To simplify servicing, all BA504D indicators use a common display assembly which can be easily replaced on site. Depending upon the accessories fitted, one spare display assembly may be used to replace any BA504D which fails. The exchange may be made without disconnecting power, the 4/20mA will continue to function but the indicator voltage drop will increase from 1V to 4V without the display assembly.

To exchange the indicator assembly, remove the terminal cover by unscrewing the two 'A' screws which will reveal two concealed 'D' screws - see Fig 4. Unscrew the four 'D' screws and carefully lift off the instrument front. The instrument assembly is secured by three Pozi headed screws which should be removed. If the instrument is fitted with a backlight the fly-lead connecting it to the terminals must be un-plugged. The replacement display assembly may then be installed and the enclosure reassembled.

If after replacement of the display assembly the instrument still does not function, it is likely that the fault is within the protection components on the terminal assembly. Terminal assemblies may be replaced on site providing instruments with a backlight are fitted with a replacement board including terminals 12 and 13.

We recommend that faulty instruments and instrument assemblies are returned to BEKA associates or to your local agent for repair.

6.4 Routine maintenance

The mechanical condition of the instrument and electrical calibration should be regularly checked. The interval between inspections depends upon environmental conditions. We recommend that initially instrument calibration should be checked annually.

6.5 Guarantee

Indicators which fail within the guarantee period should be returned to BEKA associates or our local agent. It is helpful if a brief description of the fault symptoms is provided.

6.6 Customer comments

BEKA associates is always pleased to receive comments from customers about our products and services. All communications are acknowledged and whenever possible, suggestions are implemented.

7. Accessories

7.1 Units of measurement and instrument identification

All BA504D indicators are fitted with a blank label around the liquid crystal display. This label can be supplied printed with any units of measurement and tag information specified at the time of ordering. Alternatively the information may be added on-site via an embossed strip, dry transfer or even a permanent marker.

To gain access to the display label remove the terminal cover by unscrewing the two 'A' screws which will reveal two concealed 'D' screws. Unscrew the four 'D' screws and carefully lift off the front of the instrument enclosure - Fig 4 shows the location of these screws. Add the required legend to the display label, or replace with a new pre-printed self-adhesive label which may be obtained from BEKA associates.

The BA504D can also be supplied with a blank or custom engraved stainless steel plate secured by two screws to the side of the instrument enclosure. This plate can accommodate:

- 1 row of 9 alphanumeric characters 10mm high
- or 1 row of 11 alphanumeric characters 7mm high
- or 2 rows of 18 alphanumeric characters 5mm high.

7.2 Internal Calibrator

The BA504D can be supplied with an optional internal calibrator which simulates 4 and 20mA input currents. This allows rapid calibration without the need for external instruments or disconnection from the 4/20mA input current, but it is not a substitute for calibration with a traceable external current source. Fig 6 shows the position of the calibrator link which is located behind the instrument control cover.

The plug-in root / linear link shown in Fig 6 must always be in the root position when an internal calibrator is fitted. An internal calibrator can not be fitted to an instrument with a root extractor.

When using the internal calibrator, the following procedure should be followed. The adjustments may be performed with any input current between 4 and 20mA.

- Step 1 Put the suppression / elevation, zero, span and decimal point links in the required position. Put the root / linear link in the root position.

- Step 2 Put the calibrator link in the 4mA position and adjust the indicator zero potentiometer to give the required display at 4mA.

- Step 3 Put the calibrator link in the 20mA position and adjust the indicator span potentiometer to give the required display at 20mA.

- Step 4 Repeat steps 2 and 3 until both calibration points are correct. The span and zero controls are almost independent so it should only be necessary to repeat each adjustment twice.

- Step 5 Return the calibrator link to the 'indicate' position. The indicator will now respond to the 4/20mA input current with the revised calibration.

7.3 Root extractor

The BA504D can be supplied with a square root extractor which enables the indicator to accurately display the output from a differential flow meter in linear engineering units between 10 and 100% of full flow (4.16 to 20mA). The lineariser continues to operate with reduced accuracy down to 2.5% of maximum flow, alternatively clip-off can be selected which will force the display to zero at flows below 5% (4.04mA). The location of the clip-off link is shown in Fig 7, and access to the link is gained by removing the indicator assembly as described in section 6.3

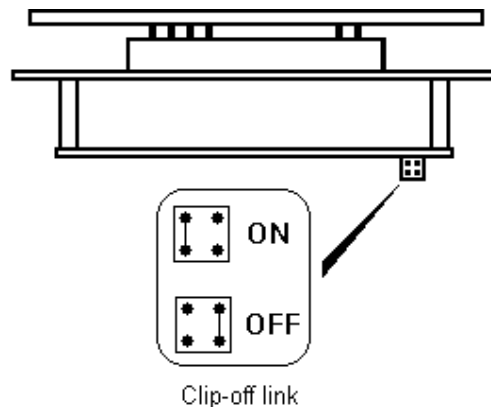


Fig 7 Location of root extractor clip-off link

When calibrating a BA504D fitted with a root extractor the indicator zero potentiometer should be adjusted to give the required display at 10% of flow (4.16mA). The indicator zero potentiometer

should not be used to set the display to zero with a 4mA input. Zero suppression or elevation may not be used, i.e. 4mA must correspond to zero flow.

For reference, the following table shows the output current from a non-linearised differential flowmeter.

% of full flow	Current output mA
2.5	4.01
10.0	4.16
25.0	5.00
50.0	8.00
75.0	13.00
100.0	20.00

A root extractor can not be fitted to an instrument with an internal calibrator.

7.3.1 Calibration example with root extractor

The BA504D is required to display rate of flow in gallons per minute, with a resolution of 0.1 gallons.

The differential flowmeter has an output of 20mA at a flow rate of 140.0 gallons per minute.

- i.e. A span of 1400 ignoring the decimal point
A decimal point in position 00.0

The following adjustments are required:

- Step 1 Put the suppression / elevation links in the elevation position.
- Step 2 Put the zero link in the 0 to 500 position.
- Step 3 The required span is 1400, therefore the span links should be placed in the 1000 to 1500 position.
- Step 4 The decimal point is required between the two least significant digits, therefore the decimal point link should be placed in the 00.0 position.
- Step 5 With 4.160mA input current adjust the zero potentiometer until the indicator displays 14.0 (10% of flow). If there is insufficient adjustment to achieve this, put the elevation/suppression links in the suppression position and repeat step 5.
- Step 6 With 20.000mA input current adjust the span potentiometer until the indicator displays 140.0
- Step 7 Repeat steps 5 and 6 until both calibration points are correct.

7.4 Display backlight

The BA504D can be supplied with LED backlighting to improve display contrast in poorly illuminated areas. The backlight is electrically isolated from the measuring circuit and may be powered from any 18 to 30V dc supply. The backlight brilliance may be reduced by reducing the supply voltage below 18V, or by fitting a current limiting resistor in series with the supply.

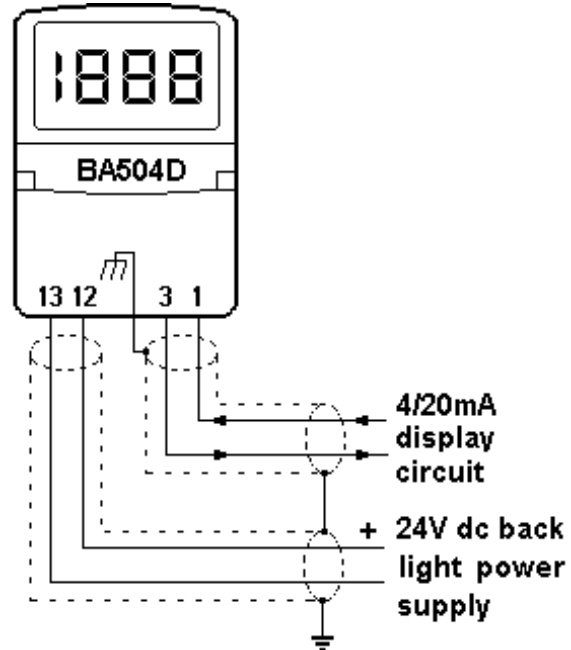


Fig 8 Backlight power supply

7.5 Pipe mounting kits

Two pipe mounting kits are available for securing the BA504D to a horizontal or vertical pipe. Detailed assembly instructions are supplied with each kit.

- BA392D Stainless steel bracket secured by two worm drive hose clips. Will clamp to any pipe with an outside diameter between 60 and 80mm.
- BA393 Heavy duty stainless steel bracket secured by a 'V' bolt. Will clamp to any pipe with an outside diameter between 40 and 80mm.

7.6 Stem mounting kit

The BA395 stem mounting kit comprises a short length of stainless steel conduit with a male M20 x 1.5 thread at both ends. Primarily intended for use with flow transmitters, the kit enables the BA504D indicator to be mounted directly onto the transmitter.